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TECHNICAL REMARKS

FY03 Systems Engineering Tools Study
Internal (KSC) Survey
External (COTS) Survey
Gap Analysis

APPROVALS

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							KSC Systems Engineering Tool Study
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KSC SYSTEMS ENGINEERING TOOLS STUDY

SEPTEMBER 12, 2003

SYSTEMS MANAGEMENT OFFICE

SAFETY, HEALTH, AND INDEPENDENT ASSESSMENT DIRECTORATE
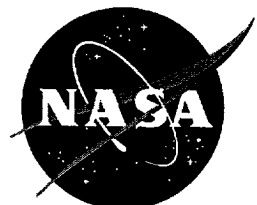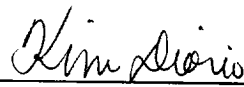
KSC SYSTEMS ENGINEERING TOOLS STUDY

Prepared by:

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This Revision Supersedes All Previous Editions of This Document

SEPTEMBER 12, 2003

JOHN F. KENNEDY SPACE CENTER, NASA

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REV LTR	CHANGE NO.	DESCRIPTION		DATE
		Basic Issue		September 12, 2003

EXECUTIVE SUMMARY

The KSC Systems Engineering Tools Study was completed in support of the Office of the Chief Engineer's (Code AE) Agencywide systems engineering (SE) initiative. This initiative is designed to establish a common framework for SE across the Agency. The framework includes SE tools, training, and policy. KSC supports the Agencywide Systems Engineering Working Group (SEWG) and has established a KSC Systems Engineering Working Group to support the SE initiative. This report attempts to baseline the various SE tools in use at KSC across all directorates performing an SE role. The baseline will serve as the foundation to move forward in identifying KSC SE enhancement methodologies.

The results of the KSC internal survey show a wide dispersion of tools designed to address each individual directorate's needs. The external survey identified commercial off-the-shelf (COTS) tools available in industry that may address KSC's needs. A preliminary gap analysis identified functional areas at KSC in need of more adequate SE tools. Two key areas include life cycle cost tools for ground support equipment/launch infrastructure and launch processing models.

The next phase will identify COTS tools with applicability to KSC SE needs and begin pilot studies to verify their applicability to KSC. Some preliminary pilot studies were started in FY03, primarily in the areas of cost estimation, work breakdown structure, and schedule development. Results will be available in FY04.

The FY04 plan will be to solicit full participation from all KSC Directorates and contractors. This report contains inputs from Shuttle (PH); International Space Station/Payloads Processing (UB); Spaceport Engineering and Technology (YA); and Safety, Health, and Independent Assessment (QA) directorates. Contractor inputs include United Space Alliance (USA) and the University-Affiliated Spaceport Technology Development Contract (USTDC). Plans will be developed to create pilot projects to address a prioritized list of needs identified at KSC and to support the Code AE systems engineering initiative to baseline SE tools across the Agency.

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CONTENTS

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ABBREVIATIONS AND ACRONYMS

CMMI	Capability Maturity Model® Integration
GSE	ground support equipment
INCOSE	International Council on Systems Engineering
IT	Information Technology Directorate
LSP	Launch Systems Programs Directorate
NPG	NASA Procedures and Guidelines
OCE	Office of Chief Engineer
PAPAC	Provide Aerospace Projects and Capabilities
PH	Shuttle Directorate
QA	Safety, Health, and Independent Assessment Directorate
SE	systems engineering
SEWG	Systems Engineering Working Group
SMO	Systems Management Office
TA	Spaceport Services Directorate
UB	International Space Station/Payloads Processing Directorate
USA	United Space Alliance
USTDC	University-Affiliated Spaceport Technology Development Contractor
YA	Spaceport Engineering and Technology Development Directorate

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KSC SYSTEMS ENGINEERING TOOLS STUDY

1. INTRODUCTION

The KSC Systems Engineering Tools Study, as outlined in the KSC Systems Engineering Plan, was designed to support the Office of the Chief Engineer (OCE) (Code AE) in the effort to establish a common systems engineering (SE) framework across NASA. The project is a multiyear effort to enhance the SE capability of both KSC and the Agency.

The SE Tools Study was conducted by a partnership between NASA and contractor support from the University-Affiliated Spaceport Technology Development Contractor (USTDC) under Task Order 1ESE-00143. The scope of the work included the following:

    a.   Internal SE tool survey.

    b.   External survey of commercial off-the-shelf (COTS) SE tools with applicability to KSC.

    c.   Preliminary gap analysis.

    d.   Generic set of SE tool requirements applicable to KSC.

    e.   Identification of candidate SE tools for pilot testing at KSC.

        (1)   Development of an evaluation matrix for the candidate SE tools.

        (2)   Start of SE tools evaluation with applicability to KSC.

Funding was provided by the Code AE in the amount of $20K and supplemented by the Office of the Associate Administrator for Aerospace Technology (Code R) in the amount of $15K for total contractor support of $35K for FY03. This report presents the results of the effort outlined above and an overview of FY04 plans. Complete details on FY04 implementation strategies and plans can be found in the FY04 Project Plan.

2. BACKGROUND

The multiyear project objective is to support the NASA Systems Engineering Implementation Plan developed and funded by Code AE as part of the Engineering Excellence Initiative. The OCE and the Center are considered the primary customers for this project. The purpose of the Systems Engineering Implementation Plan is to guide and develop a common systems engineering framework for the engineering of NASA systems within Provide Aerospace Projects and Capabilities (PAPAC) programs and projects across the Agency. The OCE initiative proposes three major activities to meet the needs of the Engineering Excellence Initiative:

- Implementation of the NASA Procedures and Guidelines (NPG) for Systems Engineering processes and requirements.

- Implementation of those workforce, methods, and tools initiatives for which the Systems Engineering Working Group (SEWG) has the assigned authority.

- Improvement of the practices of systems engineering Agencywide on a continuing basis.

The Systems Engineering Tools effort for FY03 was to establish a draft of a tool requirements document, to establish a baseline of SE tools in use at KSC, to perform a preliminary gap analysis, and to identify COTS tools that have the ability to meet KSC needs and enhance systems engineering at the Center in support of the OCE. The KSC Team has supported the Agencywide SEWG and the SE Tools Subteam in drafting the Agency's SE tools requirements. The KSC SE Tools Requirements draft should be viewed as a subset of the Agency's overall requirements.

3. FY03 APPROACH

3.1 Internal Assessment

The University-Affiliated Spaceport Technology Development Contractor (USTDC) conducted the internal assessment of tools in use at KSC. A survey was conducted with the following NASA Directorates: Shuttle (PH); International Space Station/Payloads Processing (UB); Safety, Health, and Independent Assessment (QA), and Spaceport Engineering and Technology (YA).

A representative from each directorate was contacted and meetings were held with the representatives to introduce the project objective, present the survey spreadsheet/checklist, and review a similar tools assessment chart made available by Ames Research Center.

The directorate points of contact in turn surveyed the users within their areas and input the results to the spreadsheet for inclusion in the assessment. Information was received from PH, UB, QA, and YA and was compiled into a master listing that is included as Appendix A.

The internal surveys indicate that each reporting directorate is using a variety of SE tools to accomplish their roles. The tools include COTS items as well as NASA-developed software packages. These custom packages are especially useful in areas where COTS items do not allow for tailoring to unique NASA requirements. As more internal tools are developed, it is expected that they will be added to the listing compiled through this assessment.

Inputs were also received indicating SE tools in use by United Space Alliance (USA) and by the USTDC. They are included as Appendix B.

3.2   External Assessment

The KSC Systems Management Office (SMO) conducted the external assessment of COTS SE tools for this study. The assessment consisted of research, discussion with other NASA sites, industry searches, and discussions with vendors.

A primary tool used to gather this information came from the International Council on Systems Engineering (INCOSE). This organization has performed a detailed search of COTS tools for systems engineering. INCOSE is an international organization formed to develop, nurture, and enhance the interdisciplinary approach and means to enable the realization of successful systems.

The FY03 effort was focused on the identification of all relevant SE tools in production by industry. The definition of SE tools was purposely kept very broad and included almost any type of tool used in the development and operations of a system of interest. The exceptions were that tools already in widespread use at KSC and discipline-specific tools were not included on the survey.

The next step will be to prioritize the list to address the needs identified. Once the needs are identified, the tools with the broadest applicability to the KSC missions will be assessed and pilot programs for the evaluation of the selected tool sets will be designed. Appendix C contains the COTS SE Tools identified for further evaluation in FY04.

3.3   Gap Analysis

A preliminary gap analysis was also completed in FY03. The primary method used included interviews and discussions with engineering experts in the fields of design, operations, and systems engineering.

The results indicate a need for life cycle cost tools for launch infrastructure and ground support equipment (GSE). While many tools exist for costing facilities, it appears that none have the database required for launch complexes. COTS products that were identified by the external survey do not appear to have the fidelity needed for launch infrastructure and experimental test facilities. Further studies need to be performed to determine if these tools' algorithms, with the addition of the proper databases, could be useful for KSC applications. The SE project contributed $4K to obtain a facilities cost estimation tool for use at KSC. The Spaceport Facilities Group will perform an evaluation of the tool. If the tool proves to be worthwhile, discussions with the vendor about modifications required to support GSE costing will be planned.

In addition, tools for the estimation of launch processing timelines are in development by YA. The SE Implementation Project plans to investigate the maturity level of this product for future applications and presentation to a broader audience.

In the field of requirements development and tracking, the operational organizations such as PH and UB have well-disciplined methodologies in place to support flight missions. UB has chartered NASA Engineering Training to develop a training course in this area. The launch infra-

structure, development, and GSE design efforts handle the development of requirements in various ways. FY04 plans call for the baselining of how these requirements are developed and methodologies used to track and close requirements. These areas may benefit from a standardized methodology offered by a COTS product.

Finally, the study looked at how design configuration control is handled in the GSE design arena. Methodologies currently employed date back to the Apollo era. Modernization in this area could prove to both be cost-effective and improve design configuration management. FY04 plans will examine this in more detail. It appears any tool in this area will have to be custom designed to meet KSC needs.

In conclusion, this analysis should be viewed as preliminary. FY04 will attempt to validate the results and peer-review the needs for the future.

3.4   SE Tool Pilot Programs

An initial review of the External SE Tools List and discussion with engineers in the field identified several opportunities to accelerate the process and begin pilot studies. Cost estimating for both construction of facilities and development of launch support equipment was identified as an area in particular need of tools. The Spaceport Services Directorate (TA) cosponsored a pilot project for a product called US Cost. UPN 297-20 provided $4K of the required $18K funding. TA supplied the majority of the funding. Training of KSC personnel is in progress. No evaluation data will be available until FY04.

In addition, several inexpensive packages were brought in as part of the initial pilot study. These include tools that aid in the development of work breakdown structures, Program Evaluation Review Technique (PERT) charts, and Web site development/internet applications in support of SE applications. The planned duration of the testing is 6 months. No data will be available until January 2004 because of delays in the procurement cycle in FY03. Appendix D contains the SE Tools Evaluation Checklist.

4.   FY04 PLAN

The focus on the FY04 Systems Engineering Tools, Best Practices, and Assessment Model Development task will include the following:

    a.   Refine the KSC SE Tools Requirements.

        (1)   Support the NASA SEWG Tool Subgroup in developing the Agency SE Tool Requirements.

    b.   Update and validate the tools previously identified by the NASA KSC Directorates.

(1)   Expand to include the newly formed Information Technology (IT) Directorate.

(2)   Validate FY03 inputs. Because of late funding availability for contractor support, the initial assessment was on a short time line.

(3)   Expand the study to include KSC contractors.

c.   Finalize and update the Gap Analysis.

d.   Finalize the External Survey.

(1)   Develop a ranking system for the tools that should have the greatest impact on the KSC mission.

(2)   Rank the SE tools and begin pilot programs.

(3)   Perform tool evaluations.

(4)   Develop an application design architecture and assessment methodology of SE tools at KSC.

e.   Implement SE Assessment Methodology

(1)   Familiarize key KSC SE personnel with Capability Maturity Model® Integration (CMMI).

(2)   Develop at least two KSC experts in CMMI for systems engineering.

(3)   Support other Center SE/CMMI assessments.

(4)   Establish an Engineering Process Group at KSC for systems engineering.

(5)   Support the Agency SEWG Assessment Subgroup.

5.   CONCLUSION

The SE Tools Survey received support and information from Shuttle (PH); International Space Station/Payloads Processing (UB); Safety, Health, and Independent Assessment (QA); and Spaceport Engineering and Technology (YA) Directorates. The Launch Service Program (LSP) Directorate did not respond to the survey, and the Information Technology (IT) Directorate did not exist at the time of the survey. Follow up in FY04 will be to solicit input from IT and LSP.

The results of the internal survey indicate a wide dispersion of tools in use at KSC designed to address each individual directorate's needs. This study was the first attempt at KSC to catalog the tools used across the various directorates. Many of the tools are COTS items with no modifi-

cations. Some SE tools have been designed in-house to address KSC's unique mission. This is particularly true in the launch operations modeling, GSE development and costing, and launch operations arenas.

The external survey was completed and the next phase will identify tools with application to KSC needs. The gap analysis identified areas that lack adequate tools, such as life cycle cost estimation of GSE and launch infrastructure. While there are numerous cost estimation tools on the market, COTS databases to support this effort just do not appear to exist. In addition, opportunities exist in the design of GSE and in the configuration management, requirements, and modeling arenas. Pilot projects with some of these tools began in the last quarter of FY03. These include tools for developing work breakdown structures and schedules plus a cost estimation package. The tools have not been in the field long enough to assess their suitability. The assessment will occur in FY04.

KSC supported the Agencywide SEWG Tools Subgroup. A draft requirements document was developed to support the Agency group. The plan will be peer-reviewed in FY04 by the appropriate KSC organizations. KSC will continue to support the Agency Tools Subgroup.

The FY04 plan will be to attempt to gain full participation in the survey from all KSC Directorates engaged in systems engineering. Two directorates, as noted previously, were not included in the survey. The survey results will be posted on the SMO Web page. Plans will be put into place to develop pilot projects to address the prioritized list of needs. The SE tools assessment methodologies that are being planned for development in FY04 will be used to evaluate these pilot studies.

APPENDIX A.   INTERNAL SURVEY RESULTS – NASA KSC

A.1   Internal Survey Results – Consolidated

KSC Systems Engineering Tools Survey															
Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorates: Shuttle (PH); Safety, Health, and Independent Assessment (QA); ISS/Payloads Processing (UB); Spaceport Engineering and Technology (YA)
AATe		x	x												YA
Adobe Acrobat				x	x										QA, UB
ANSYS/Mechanical			x												YA
Artemis												x			PH
AutoCAD	x	x	x					x							PH, UB, YA
Automated Requirements Measurement Tool				x											PH, QA
Catia	x	x													PH
CORE		x													YA
CVS					x										PH
Documentum				x	x		x						x		PH
DOORS				x	x										PH
Elog														x	PH
EXCEL			x		x	x		x			x				PH, QA, UB
FlowCharter		x													PH, QA
GE CIMplicity HMI Plant Edition	x					x									YA
GE CIMplicity Machine Edition Logic Developer	x														YA
GE Logicmaster Programmer & Configurator Pkg	x					x	x								YA
GEMFLO		x	x												YA
Insight (Surveillance Data System)			x			x		x						x	PH
JMP Discovery								x							QA
Kaleidagraph			x												YA
LabView	x	x	x			x									UB, YA
Maple								x							QA

KSC Systems Engineering Tools Survey

Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorates: Shuttle (PH); Safety, Health, and Independent Assessment (QA); ISS/Payloads Processing (UB); Spaceport Engineering and Technology (YA)
MathCAD			x					x							PH, UB, YA
Mathematica								x							QA
MathType (for writing technical data-communication)						x									QA
MATLAB			x					x							UB, YA
MicroStation			x												YA
Microsoft Project								x				x	x	x	PH, QA, UB
Microsoft Visual Studio.Net		x					x								YA
NAFCOM											x				QA
PASS 1000 Software			x												UB
PASS 3200 Dual channel			x												UB
Pert Chart Expert								x							PH, QA
Photoshop						x									UB
Price											x				QA
Pro-E	x	x	x		x			x	x						PH, UB, YA
Protel	x	x	x												YA
PSPICE	x	x	x												UB
RADCAD			x												YA
Razor's Tracking										x					PH
Relex Software	x		x					x						x	QA
Risk Radar										x					QA
SAS								x							QA
Satellite Tool Kit (STK)		x	x					x							YA
SEER											x				QA
Shuttle Sim		x	x												YA
Simion	x	x	x												YA
SinapsPlus			x												YA
SINDA/FLUINT			x												YA
Surveillance													x	x	PH
Thermal Desktop			x												YA

Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorates: Shuttle (PH); Safety, Health, and Independent Assessment (QA); ISS/Payloads Processing (UB); Spaceport Engineering and Technology (YA)
TurboCAD 9 Professional	x														YA
U.S. Cost (pilot project)											x		x		QA
VISIO	x	x			x										UB
Visio Technical	x														PH, QA
Visual Basic	x	x													UB
VRC						x									YA
WBS Chart Pro												x	x		QA

KSC Systems Engineering Tools Survey

A.2   Internal Survey Results – Raw Data

KSC Systems Engineering Tools Survey															
Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorate
Adobe Acrobat				x	x										QA
Automated Requirements Measurement Tool				x											QA
EXCEL			x		x	x		x			x				QA
FlowCharter		x													QA
JMP Discovery								x							QA
Maple								x							QA
Mathematica								x							QA
MathType (for writing technical data-communication)															QA
Microsoft Project												x	x	x	QA
NAFCOM											x				QA
Pert Chart Expert															QA
Price											x				QA
Relex Software	x		x					x						x	QA
Risk Radar										x					QA
SAS								x							QA
SEER											x				QA
U.S. Cost (pilot project)											x		x		QA
Visio Technical	x														QA
WBS Chart Pro												x	x		QA
Artemis												x			PH
AutoCAD	x	x	x						x						PH
Automated Requirements Measurement Tool				x											PH
Catia	x	x													PH
CVS					x										PH
Documentum				x	x		x						x		PH
DOORS				x	x										PH

KSC Systems Engineering Tools Survey															
Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorate
Elog														x	PH
EXCEL		x			x	x		x				x			PH
FlowCharter		x													PH
Insight (Surveillance Data System)		x				x		x						x	PH
MathCAD		x						x							PH
Microsoft Project												x	x	x	PH
Pert Chart Expert								x							PH
Pro-E	x	x						x	x						PH
Razor's Tracking										x					PH
Surveillance												x		x	PH
Visio Technical	x														PH
AATe		x	x												YA
ANSYS/Mechanical			x												YA
AutoCAD			x												YA
CORE		x													YA
GE CIMplicity HMI Plant Edition	x					x									YA
GE CIMplicity Machine Edition Logic Developer	x														YA
GE Logicmaster Programmer & Configurator Pkg	x				x		x								YA
GEMFLO		x	x												YA
Kaleidagraph			x												YA
LabView	x	x	x												YA
MathCad			x												YA
MATLAB			x												YA
MicroStation			x												YA
Microsoft Visual Studio.Net		x					x								YA
Pro-E			x												YA
Protel	x	x	x												YA
RADCAD			x												YA
Satellite Tool Kit (STK)		x	x					x							YA
Shuttle Sim		x	x												YA

KSC Systems Engineering Tools Survey

Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Directorate
Simion	x	x	x												YA
SinapsPlus			x												YA
SINDA/FLUINT			x												YA
Thermal Desktop			x												YA
TurboCAD 9 Professional	x														YA
VRC						x									YA
AutoCad	x	x	x												UB
Excel/Office Suite			x					x							UB
LabView	x	x	x			x									UB
MathCad			x					x							UB
MATLAB								x							UB
Microsoft Project								x							UB
PASS 1000 Software			x												UB
PASS 3200 Dual channel			x												UB
Photoshop					x										UB
Pro-E	x	x	x		x				x						UB
PSPICE	x	x	x												UB
VISIO	x	x			x										UB
Visual Basic	x	x													UB

APPENDIX B. INTERNAL SURVEY RESULTS – CONTRACTOR KSC

Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Contractor: United Space Alliance (USA) University-Affiliated Spaceport Technology Development Contract (USTDC)
AATe		x	x								x				USTDC
Adobe Acrobat			x	x	x						x	x	x	x	USTDC
All Fusion Harvest					x										USA
Allegro Common Lisp	x	x	x		x		x	x							USTDC
ANSYS	x	x	x												USA
BEASY Mechanical Design	x	x	x												USA
C++							x								USTDC
Construx											x	x			USA
CORE		x													USTDC
Crystal Ball								x		x					USA
EXCEL	x	x	x	x	x			x	x		x	x	x	x	USTDC
Expert Choice								x		x					USA
FileMaker Pro								x		x	x	x	x		USTDC
FLAGRO	x	x	x												USA
FlowCharter	x	x	x									x	x	x	USTDC
Flowmaster	x														USA
GEMFLO		x	x												USTDC
GNU Emacs	x	x	x		x		x								USTDC
Imagine That- Extend	x	x													USA
KBSI-AIO/SIM	x	x													USA
KBSI-Pro/SIM	x	x													USA
Labview		x				x		x							USTDC
MicroCADAM	x	x	x												USA
Microsoft Access		x	x	x	x		x	x			x		x		USTDC
Microsoft PowerPoint	x		x	x				x		x	x	x	x	x	USTDC
Microsoft Project				x							x	x	x	x	USTDC
Microsoft Word	x	x		x	x		x			x	x		x	x	USTDC
MicroStation	x	x						x	x						USA, USTDC
Milestones, Etc												x			USA
NAFCOM											x				USA

Engineering Tool	Design	Modeling & Simulation	Engineering Analysis	Requirements Management	Configuration Control	Data Acquisition	Software Development	Numerical Analysis & Trending	Human Factors	Risk Management	Cost Estimation	Scheduling	Project Management	Operations Analysis	Contractor: United Space Alliance (USA) University-Affiliated Spaceport Technology Development Contract (USTDC)
NASTRAN			x					x							USA
PATRAN	x	x	x												USA
Photoshop	x		x		x	x									USTDC
Price											x				USA
PRO-E	x	x	x												USTDC
Pro-Model	x	x													USA
Reason Tool										x					USA
Relex Fault Tree Analysis			x							x					USA
SDRC	x	x						x	x						USA
SEER											x				USA
ShuttleSim		x	x												USTDC
Staadt	x		x												USTDC
STK		x													USTDC
TurboCAD	x		x												USTDC
VRC					x										USTDC
WBS Chart Pro												x	x		USA

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APPENDIX C.   COTS TOOLS FOR EVALUATION IN FY04

Tool Name	Vendor	Description	Notes
@Risk for Project	Palisade Corp	Add-on risk analysis tool to analyze Microsoft Project schedules using Monte Carlo simulations of tasks and resources.	www.palisade.com
ACEIT	AF/Army	Automated Cost Estimating Integrated Tools. An estimating tem containing tools to assist in conducting cost analysis activities such as cost estimates, what-if studies, life cycle cost models, cost proposal evaluations, and risk and uncertainty analysis.	www.aciet.com
ADAMS	Mechanical Dynamics, Inc.	Virtual prototyping and mechanical system simulation software.	www.adams.com
AIO WIN	Knowledge Based Systems	Function modeling tool.	www.kbsi.com
AnalystStudio	Rational Software	Tool Suite, Rational Rose, etc.	www.rational.com
ANOVA-TM	Advanced Systems & Design	Experiment design software.	http://www.asdspc1.com /anova_tm.htm
Automated Test Planning System	SAIC	Set of rule-based software tools to improve quality of test planning.	http://www.stsc.hill.af .mil/crosstalk/1994/11 /automate.asp
AutoSketch	Autodesk	Technical drawing.	www.autodesk.com
CAFTA	SAIC	Fault tree development tool.	http://www.ds-s.com
CAME	BQR	Computer-aided maintenance engineering.	www.bqr.com
CCC/Harvest	Computer Associates	Configuration management tool.	www.cai.com
ClearCase	Rational Software	Configuration management tool.	www.rational.com
CoCoPro	ICONIX	Construction cost model.	www.iconixsw.com
Continuous/CM	Telelogic	Configuration management tool.	www.continuus.com
Control-CS	Network Concepts, Inc	Configuration management tool.	http://www .nci-sw.com/control -cs.html
Core	Vitech	Life cycle systems engi-	www.vtcorp.com

Tool Name	Vendor	Description	Notes
		neering tool.	
Cost$Benefit Analysis tool	Legacy Systems Research	Cost benefit analysis.	www.costbenefit.com
Data Drill	Distributive Software	Tool for managing/developing systems.	www.distributive.com
Enterprise Arch Development	Booz Allen Hamiltion	Enterprise Arch Development and Management tool.	www.boozallen.com
DOORS	Telelogic	Enterprise Requirements Suite.	www.telelogic.com
IrqA	IrqA	Requirements Development.	www.irqaonline.com
Cradle-4	3SL	Requirements/Project management tool.	www.threesl.com
Data Desk	Palisade Corp.	Data analysis tool.	www.palisade.com
Design for Assembly Design for Environment Design for Service	Boothroyd Dewhurst, Inc.	Suite of tools for assessing design and cost issues.	www.dfma.com/software
Expert Choice Professional	Expert Choice, Inc	Decision support software.	www.expertchoice.com
Facilitate	Facilitate	Team collaborative tool.	www.facilitate.com
FaultrEASE	Author D. Little	Fault tree tool.	www.process-safety.com
FaultTree+	Rams Intl.	Fault tree tool.	www.isograph.com
FMEA Plus	Ford	Failure mode analysis and effect tool.	www.amsup.com
Group Systems	Group Systems	Team collaborative tool.	www.groupsystems.com
HazOPPlus	Item Software	Tool for haz ops studies.	www.itemsoft.com
I-DEAS	SDRC	3-D CAD tool.	www.sdrc.com
IcConcept	Integrated Chipware	Requirements traceability tool.	www.chipware.com
IGrafx Designer	Micrografx	Technical drawing tool for Office.	www.micrografx.com
ITEM Toolkit	ITEM Software	Reliability tool.	www.itemsoft.com
Logical Decision	Logical Decisions	Decision support tool.	www.logicaldecisions.com
Maple	Waterloo Maple	Math program.	www.maplesoft.on.ca
MATLAB	The MathWorks	Math program	www.mathworks.com
MechStress	Item Software	Failure rate for mechani-	www.Itemsoft.com

Tool Name	Vendor	Description	Notes
		cal parts.	
MilStress	Item Software	Failure rate for electrical parts.	www.itemsoft.com
Monte Carlo	Primavera Systems	Tool to simulate project performance.	www.primavera.com
Orbit Analysis System	Integral Systems	Satellite orbit and attitude analysis.	www.integ.com
ORCA	Telelogic	UML tool for analysis.	www.telelogic.com
C-Brat	STI	Cost benefit/risk tool.	http://www.sti-inc.com
Precision Tree	Palisade Corp	Excel add-on for risk using Monte Carlo simulation.	www.palisade.com
Prism	Reliability Anaylsis	Systems reliability assessment tool.	http://rac.allowscience.com
Real Time Modeler	ARTiSAN Software	UML modeling tool.	www.artisansw.com
Relex	Relex Software	Reliability prediction, FMEA/FMECA software.	www.relexsoftware.com
RequisitePro	Rational SW	Requirements traceability tool.	www.rational.com
Risk Radar	Software Program Managers Network	Risk management tool.	http://www.zurichservices.com
Risk +	C/S Solutions	Risk analysis add-on for MS Project.	www.cs-solutions.com
Rose	Rational SW	SW modeling tool.	www.rational.com
Satellite Tool Kit	Analytical Graphics	Analysis and design of satellite systems.	www.stk.com
Smartdraw	SmartDraw SW	Flowcharting and diagramming tool.	www.smartdraw.com
System Architect	Popkin Swand Systems	Structured analysis and design tool.	www.popkin.com
TAU	Telelogic	UML tool.	www.telelogic.com
WindChill	Parametric Tech Corp	Product development tools.	www.ptc.com
Winsight	C/S Solutions	Cost performance measurement.	www.cs-solutions.com

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APPENDIX D. SYSTEMS ENGINEERING TOOLS EVALUATION CHECKLIST

Systems Engineering Tools Evaluation						
Name of Tool:	**Date of Evaluation:**		**Name of Evaluator:**			
INSTALLATION						
Scoring System: **5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree**						
Question	5	4	3	2	1	Comments
The product was easily installed.						
The instructions/Help were adequate for installation.						
No configuration/compatibility problems occur on my PC after installation.						
Training/Learning the tool						
Question	5	4	3	2	1	Comments
The tool was easy to learn.						
The manual or help files were easy to understand.						
The manual or help files were usefulness.						
The tool can be easily self-taught.						
The tool is complicated to learn and a training course in its operation should be provided.						
Usability						
Question	5	4	3	2	1	Comments
The tool performed as expected.						
The tool is flexible.						
The tool is easy to navigate.						
The tools error messages are easily understood and corrected.						
The tool is generally user-friendly.						

Functionality						
Question	5	4	3	2	1	Comments
The tool increased my productivity.						
The tool improved my ability to complete the task.						
The tool is compatible with other tools used in completing the desired output.						
The tool's functionality is narrow and not universally applicable to producing the desired output.						
I would recommend the tool to others.						
NASA should adopt the tool as the standard for producing the desired output.						

Please indicate the type of system on which the tool was installed.
1. PC
2. MAC
3. Server
4. Other _____

Please indicate how thoroughly the product was test by circling one of the following.

Heavily used (over 50 times during evaluation period).
Moderately used (between 10 and 50 times during evaluation period).
Lightly used (less than 10 times during evaluation period).

Please explain any software configuration problems encountered.

_____

_____

_____

_____

Did the tool cause any system crashes? If so, please explain.

_____

_____

_____

_____